



S2913

**PATENT**  
Docket No. 543822005300

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In the application of:

Steven WANG et al

Examiner: Ha, Nathan W.

Group Art Unit: 2814

Serial No.: 10/812,412

Filing Date: March 30, 2004

For: **METHOD FOR PRODUCING A DEEP  
TRENCH CAPACITOR IN A  
SEMICONDUCTOR SUBSTRATE**

**DECLARATION UNDER 37 CFR 1.131**

MS AMENDMENT  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Sir:

I, Steven WANG, declare under penalty of perjury under the laws of the United States of America as follows:

- (1) I am one of the joint inventors, who filed the above-identified application on March 30, 2004.
- (2) The invention claimed in the subject application was completed prior to the January 28, 2004 filing date of the Seidl et al. reference (US 2005/0037565 A1). Please be advised that the invention report for this invention was made on August 27, 2003. A copy of the INTA Invention Disclosure form stamped August 28, 2003, is enclosed for your convenience.

(3) I do not know and do not believe that the invention has been in public use or on sale in this country, or patented or described in a printed publication in this or any other foreign country for more than one year prior to our application, and I have never abandoned our invention.

(4) The undersigned declares further that all statements made herein of his own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

I declare under penalty of perjury under the laws of the United States that the foregoing is true and correct. Executed at Taipei, on this 28th day of December 2006.

Steven (Hsien-Ting) Wang  
Steven WANG



INTA  
**Patent**

Erreasing

28. Aug. 2003

Semiconductor300



INTA  
**INVENTION DISCLOSURE**

INTA 5056  
INTA Doc.No.

2003E54986 DE  
2003P54987

<b>TITLE OF INVENTION (Short &amp; Descriptive)</b>
New Integrated Deep Trench process combines with bottle and HSG (rugged poly) process

Date of Entrance:

**INVENTOR INFORMATION**

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<b>PART IN INVENTION (%)</b>	50
<b>COMMENTS</b>	

**INVENTOR INFORMATION**

<b>INVENTOR #2</b>	
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<b>CITIZENSHIP</b>	Taiwan
<b>PART IN INVENTION (%)</b>	50
<b>COMMENTS</b>	

# SIGNATURES

**IMPORTANT:** Information provided by this form may be used to prepare a patent application which will be signed by the inventor(s). Inventors should take great care in accurately completing this form and in providing full information concerning prior art. False statements or concealment of relevant information (relating prior art, similar invention disclosures, etc.) may jeopardize the validity of the patent.

<u>Steven Wang</u>	<u>25/08/2003</u>	<u>Kae Hong Way</u>	<u>27/08/2003</u>
Inventor #1's Signature	Date	Inventor #2's Signature	Date
Inventor #3's Signature	Date	Inventor #4's Signature	Date
Inventor #5's Signature	Date	Inventor #6's Signature	Date
Inventor #7's Signature	Date	Inventor #8's Signature	Date

## WITNESSES

<b>Witnessed and understood by:</b>	<b>Witnessed and understood by:</b>
<u>M. Seitz</u>	<u>Kuan-chun yi</u>
Signature of Witness	Signature of Witness
<u>27.8.03</u>	
Date	Date
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<b>IFD</b>	<b>IFD MDC NANYA</b>
Company Name/Location	Company Name/Location

## DESCRIPTION

**PLANNED USE IN PRODUCTS; USE OUTSIDE COMPANY, DEMONSTRATION, DISCLOSURE, OR PUBLICATION OF THE INVENTION - (GIVE DATES)**

90NM , 70NM DRAM

## DESCRIPTION OF INVENTION

You can use the Invention Disclosure Word form and/or the Invention Disclosure Presentation form for the description of your invention and for the preparation of the Patent Board presentation. Please store the file(s) with the description of your invention on your H-drive and then attach the files under **Documents**. If there are any documents or former invention disclosures with relevance to the same topic available, please attach the files or give title and number.

You can download the invention disclosure form in German and English from the homepage of CPC IC:  
[http://intra.muc.infineon.com/intellectual\\_property/eng/patents-trade/formulare.htm](http://intra.muc.infineon.com/intellectual_property/eng/patents-trade/formulare.htm)

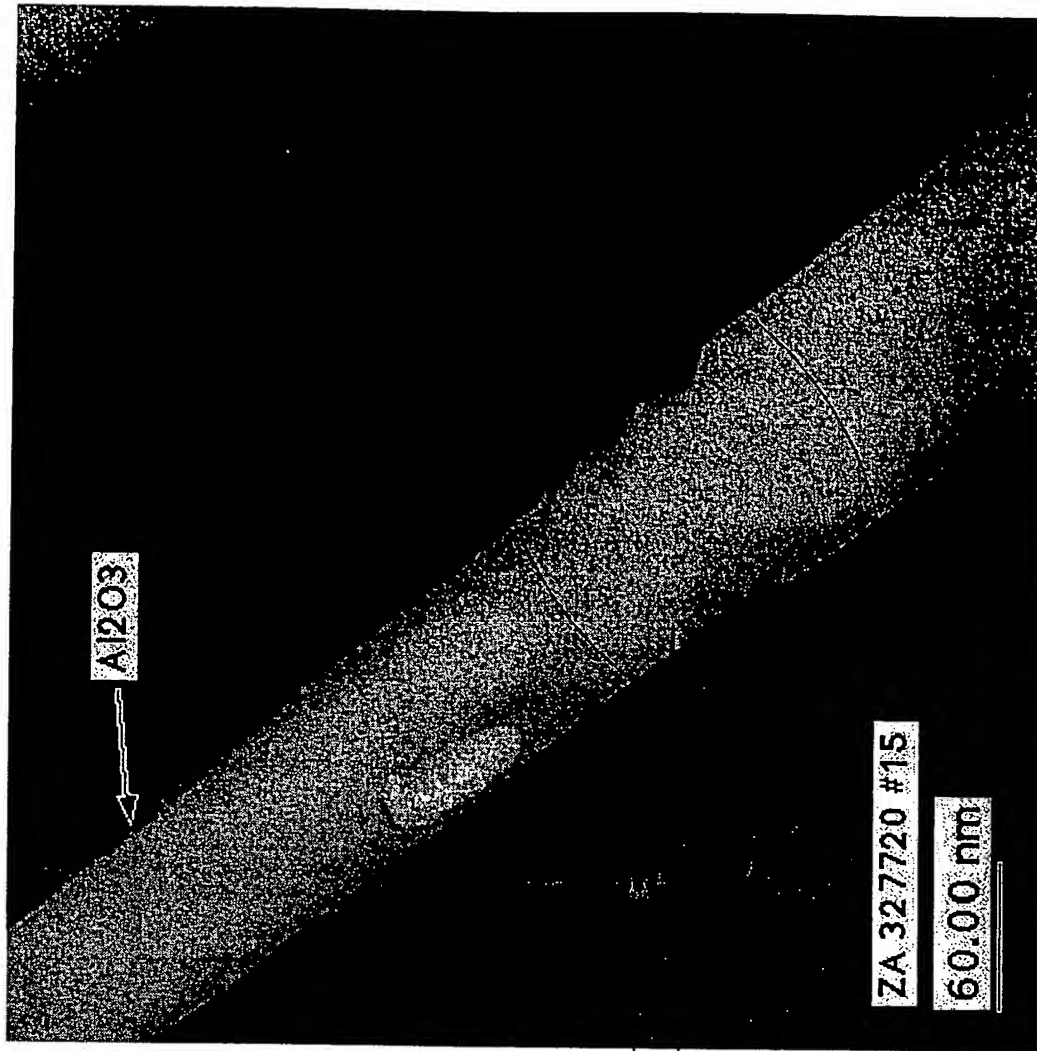
## Documents:



Integrated deep trench process combine with bottle and HSG proce

# Closest Prior Art Comparison

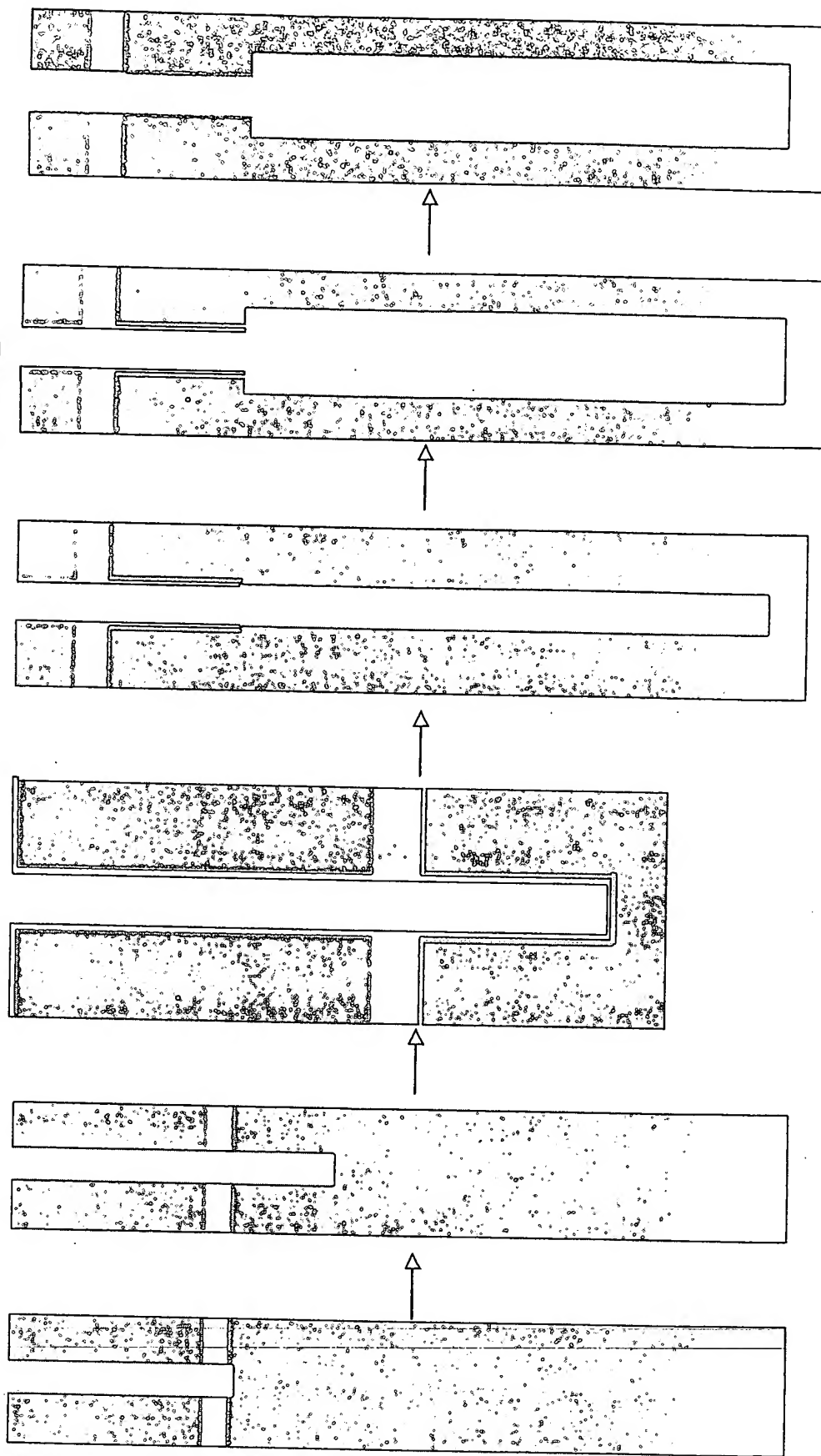
Non-conformal  
Al<sub>2</sub>O<sub>3</sub> mask for  
wet bottle process



Transition area with  
indefinite thickness  
of Al<sub>2</sub>O<sub>3</sub> liner

# Description of the Invention

DTMO  
1st DT etch  
Oxidation & Al<sub>2</sub>O<sub>3</sub> liner dep  
Liner open & 2nd DT etch  
Wet bottle (or RIE bottle during DT etch) & GPD  
Al<sub>2</sub>O<sub>3</sub> removal



Inventors  
S. Wang  
H. Wang  
H. Wang

Description of the Invention

HSG

(rugged poly)

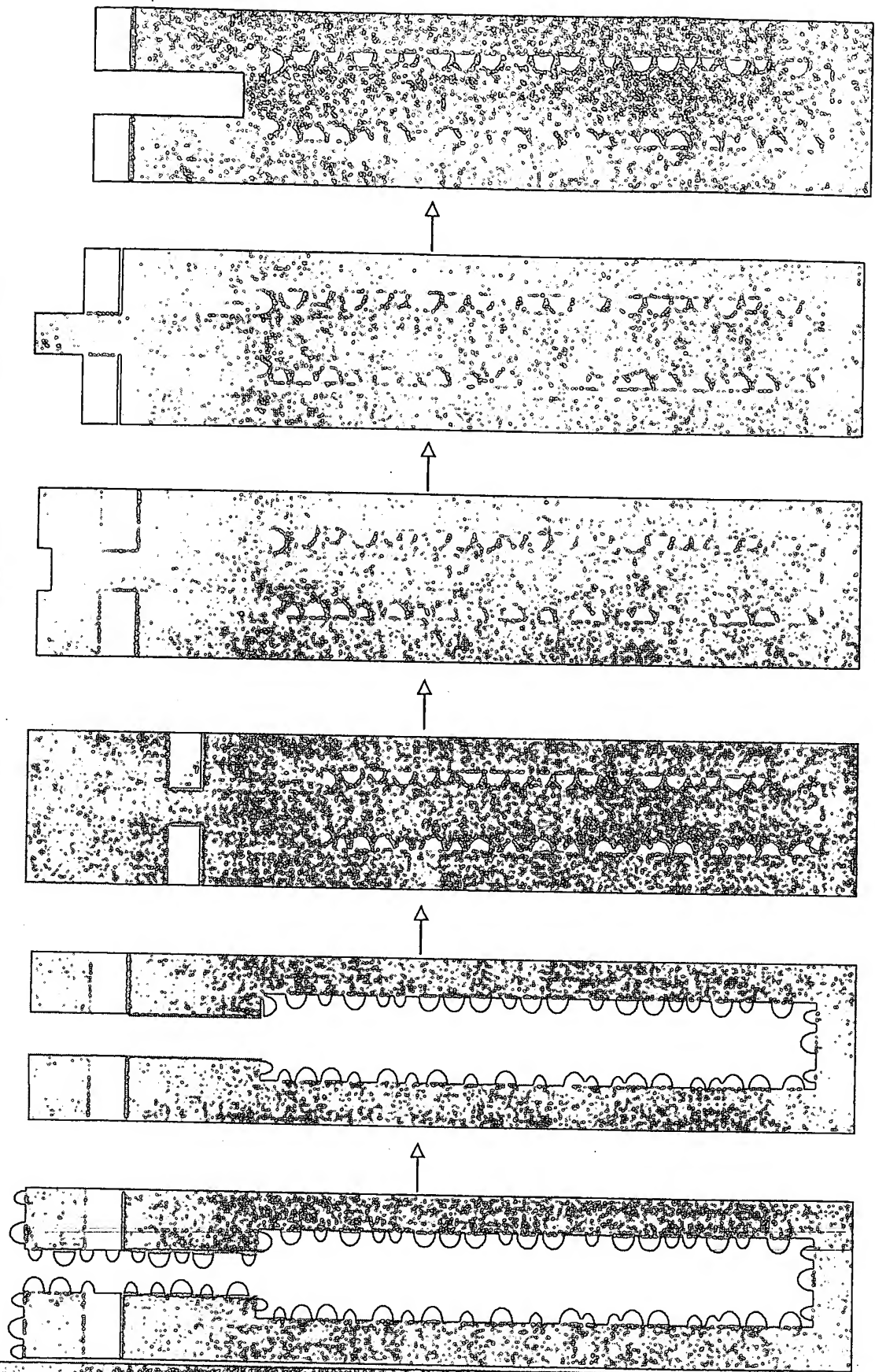
HSG recess

NO Node ,  
Poly fill

Etch  
planarization

Oxide HM  
removal

Recess 1

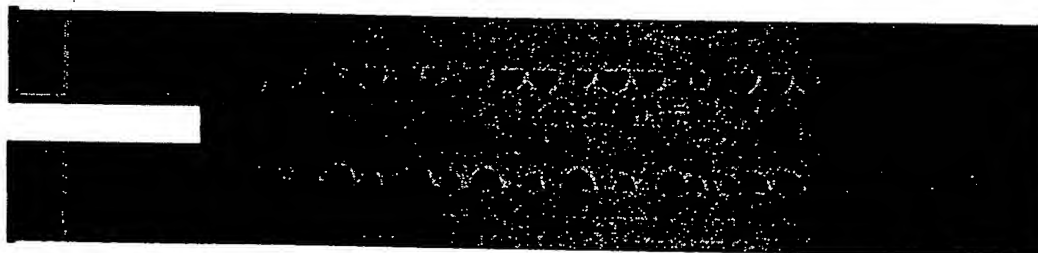




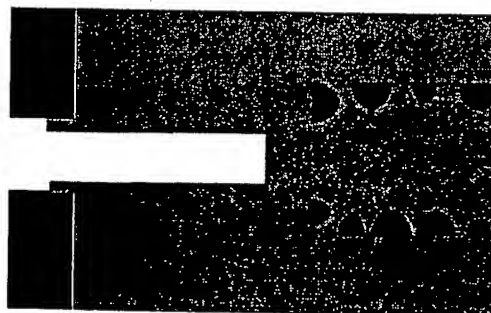
# Description of the Invention

## Conventional process

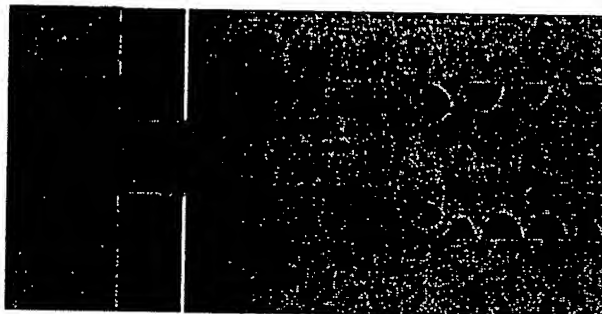
Collar  
deposition



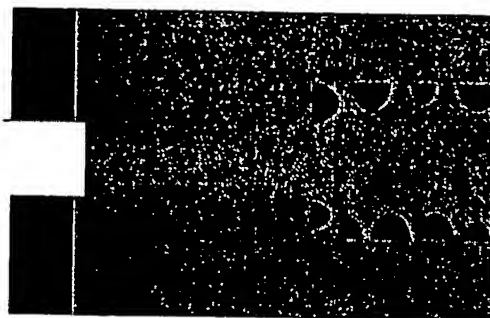
Collar etch



Poly2  
deposition



Recess 2 , BS nitride ,  
Poly3 deposition , Poly  
CMP and Recess 3



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Inventors  
S. Wang  
M. C. Tsai  
K. H. Wang  
H. C. Tsai

## How is your Invention Unique?

- 2 step DT etch in combination with conformal ALD deposition as SAC Collar
  - Height of bottle and top CD defined by the first DT etch
  - Standard conformal ALD liner with better process monitor and tool control than NOLA process
  - Better bottled DT profile at boundary (No transition area like NOLA process , page 1)
  - Thin ALD liner (e.g. Al<sub>2</sub>O<sub>3</sub>) easily opened by etch process
  - Top area protected by SAC liner. No further CD widening. Enlargement of process window at 2nd DT etch or dry bottle process
- USG as HM for both of the DT etch steps (remove after poly fill)
  - Better selectivity than USG/BSG for deeper DT
  - USG HM removal w/o Pad Oxide undercut
- Implementation of wet bottle process , non selective HSG and GPD

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# Competitive Advantage to Infineon Technologies

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- Un-doped Oxide (USG) HM provides better selectivity for DT etch , also benefit for deeper DT
- Conformal ALD deposition with standard tool control supported by vendor
- Top of bottled DT can be easily monitored by PFA (before ALD process)
- Al<sub>2</sub>O<sub>3</sub> liner is uniform (step coverage > 95%)
- No CD widening at second DT etch , better for whole process control at DT module

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# Evaluation of Invention Disclosure INTA XXXX

INTA 5051

What is the inventive step ? What is really new ?

New concept to monitor short performance of FEOL up to IT.

How has been solved the problem so far ? (Usable status of technique)

- 1) DT shorts are monitored by CMP short loop and/or electrical short loop.
- SSBS shorts are monitored at C1 test with special test structure.

Benefit of this invention is for Infineon ...

Feedback loops are shortened. High statistics might be obtained if concepts works.

Disadvantages of this invention are ...

SSBS shorts can not be distinguished from AA-DT shorts or DT-DT shorts. Extra complexity.

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# Evaluation of Invention Disclosure INTA xxxx

## Innovation value of invention :

6 (technological break through) ... 4 (important development step) ...  
2 (detail improvement) ... 0 (no improvement)

2

## Importance of invention for Infineon:

6 (strategic importance) ... 4 (probably futural importance) ...  
2 (subordinated relevance) ... 0 (no relevance)

4

## Practicability:

6 (immediately possible use) ... 4 (further tests necessary) ...  
2 (further considerable development work necessary) ... 0 (no practicability)

2

## Competition advantage:

6 (high, unique selling proposition) ... 4 (medium, alternative solution only with additional work) ...  
2 (low, alternative solutions available) ... 0 (no advantage)

2

## Proof of usage:

6 (at products) ... 4 (at standard manufacturing equipment) ...  
2 (only within manufacturing line) ... 0 (nearly impossible)

0

## Your Recommendation: File for patent.

\* Please enter number between 6 and 0

Did you spoke with one of the inventors about your evaluation ?      No

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# Evaluation of Invention Disclosure Nr. INTA5056

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What is the basic idea of that Invention Disclosure, what will be improved ?

To improve NOLA non-conformal situation for wet bottle process.

How has the problem been solved so far (usable status of technique) ?

Optimize NOLA recipe.

What is the inventive step ? What is really new ?

Modified CFE concept , deposit Al<sub>2</sub>O<sub>3</sub> like node before DT2 etch.

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# Evaluation of Invention Disclosure Nr. INTA5056

Is the idea of that Invention Disclosure useful for IFX and/or NTC ?

Maybe.

Which companies could have an interest in using or owning this Invention ?

NA

Are there any disadvantages for this Invention ?

NA.

1. Your Recommendation

File for Paten.

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